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CASE REPORT: CLINICAL CASE

Intermittent Normal Ventricular Conduction in Left Bundle Branch Block After TAVR

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ABSTRACT

In a patient who previously developed left bundle branch block after transcatheter aortic valve replacement, intermittent narrow QRS complexes were recorded on ambulatory electrocardiography monitoring. The peculiar distribution of wide and narrow QRS complexes suggested the presence of a window of supernormality in the refractory period of a branch block that on other occasions exhibited the Wenckebach phenomenon. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2023;15:101865) © 2023 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

An 87-year-old male patient with no previous cardiac history was admitted to the Cardiology Department for severe aortic stenosis symptomatic for dyspnea. On admission the electrocardiogram showed normal intraventricular conduction (**Figure 1A**). He underwent transcatheter aortic valve replacement (TAVR) with a self-expanding valve (ACURATE neo2, size M, Boston Scientific). Following the evidence of periprosthetic regurgitation on angiographic control, postdilation via a 22-mm balloon was performed. The patient subsequently developed a new onset left bundle branch block (LBBB) (Supplemental Figure 1); given the stability of the QRS width in the following hours and the absence of further complication, the patient was discharged on the third day, asymptomatic.

LEARNING OBJECTIVES

- To identify the mechanisms that may underlie complex conduction disturbances after TAVR.

Two weeks later, he underwent 24-hour ambulatory 3-lead electrocardiography monitoring: noncontinuous strips are shown (**Figures 1B to 1D**).

DIAGNOSIS

The diagnosis was thought to be one of the following: 1) alternating bundle branch block; 2) supernormal conduction in the left bundle branch (LBB); 3) premature ventricular beats originating in the left ventricle with fusion beats; or 4) improvement in impulse propagation in the working myocardium attributable to reverse remodeling after TAVR.

DISCUSSION

The tracing revealed sinus rhythm with wide QRS complexes in most of the beats (0.16 seconds, compatible with the LBBB developed by the patient following TAVR) (Supplemental Figure 2). However, some intermittent narrow QRS complexes (0.11 seconds) could be seen (**Figures 1B to 1D**). On some

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ABBREVIATIONS AND ACRONYMS

LBB = left bundle branch

LBBB = left bundle branch block

TAVR = transcatheter aortic valve replacement

occasions, these narrow complexes followed a premature atrial beat, but in other cases no significant difference occurred in the RR interval preceding the narrow beat. Duration and morphology of narrow beats, added to the stability of the PR intervals, were not consistent with alternating bundle branch block (option 1). The absence of isolated right bundle branch block pattern premature ventricular beats and of variable degrees of fusion made option 3 unlikely. Regarding option 4, in this patient the onset of the LBBB occurred in conjunction with balloon postdilation, and was therefore more consistent with intraprocedural traumatic disruption of the conduction system. This presentation was, on the other hand, compatible with 2 different phenomena, the first being supernormal conduction in the LBB facilitated by linking.

In patients with a conduction disturbance, supernormal conduction is defined as an improvement in impulse conduction following relatively early impulses, with respect to later impulses. The presence of the aforementioned phenomenon in this patient was supported by the evidence of narrow QRS complexes following premature atrial beats (**Figure 1B**). However, supernormal conduction alone does not explain the alternating intermittent LBBB shown in **Figure 1C**, in which the linking phenomenon was superimposed, consisting of concealed retrograde penetration of the impulse in the anterogradely blocked bundle branch (see **Figure 1E** for explanation).[1,2]

Finally, **Figure 1D** shows improved conduction in periodic beats with an allorhythmic distribution. This is attributable to one distinct mechanism: the concealed Wenckebach phenomenon in the LBB. As shown in **Figure 1F**, progressively slower conduction occurs in the left bundle until conduction fails entirely within the LBB, allowing recovery in the next beat; the cycle then repeats.[2,3]

At first glance, these 2 mechanisms might seem in conflict, as an antidromic or retrograde invasion of the LBB from the right ventricle would reset its refractory period and interrupt the Wenckebach sequence. But the noncontinuous strips reported may represent different functional moments in the conduction system, with phases in which the transseptal passage of the impulse and the subsequent occult retrograde penetration of the LBB do not occur, revealing the Wenckebach 3:2 phenomenon in the LBB.

With the spread of transcatheter valve interventions, more and more attention is being directed toward conduction disturbances following TAVR; the one reported herein is a rare manifestation of intraventricular conduction disease, hiding interesting electrophysiological mechanisms.

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REFERENCES

1. Luzza F, Oreto G, Donato A, Satullo G, Scimone IM. Supernormal conduction in the left bundle branch unmasked by the linking phenomenon. *Pacing Clin Electrophysiol*. 1992;15(9):1248–1252.

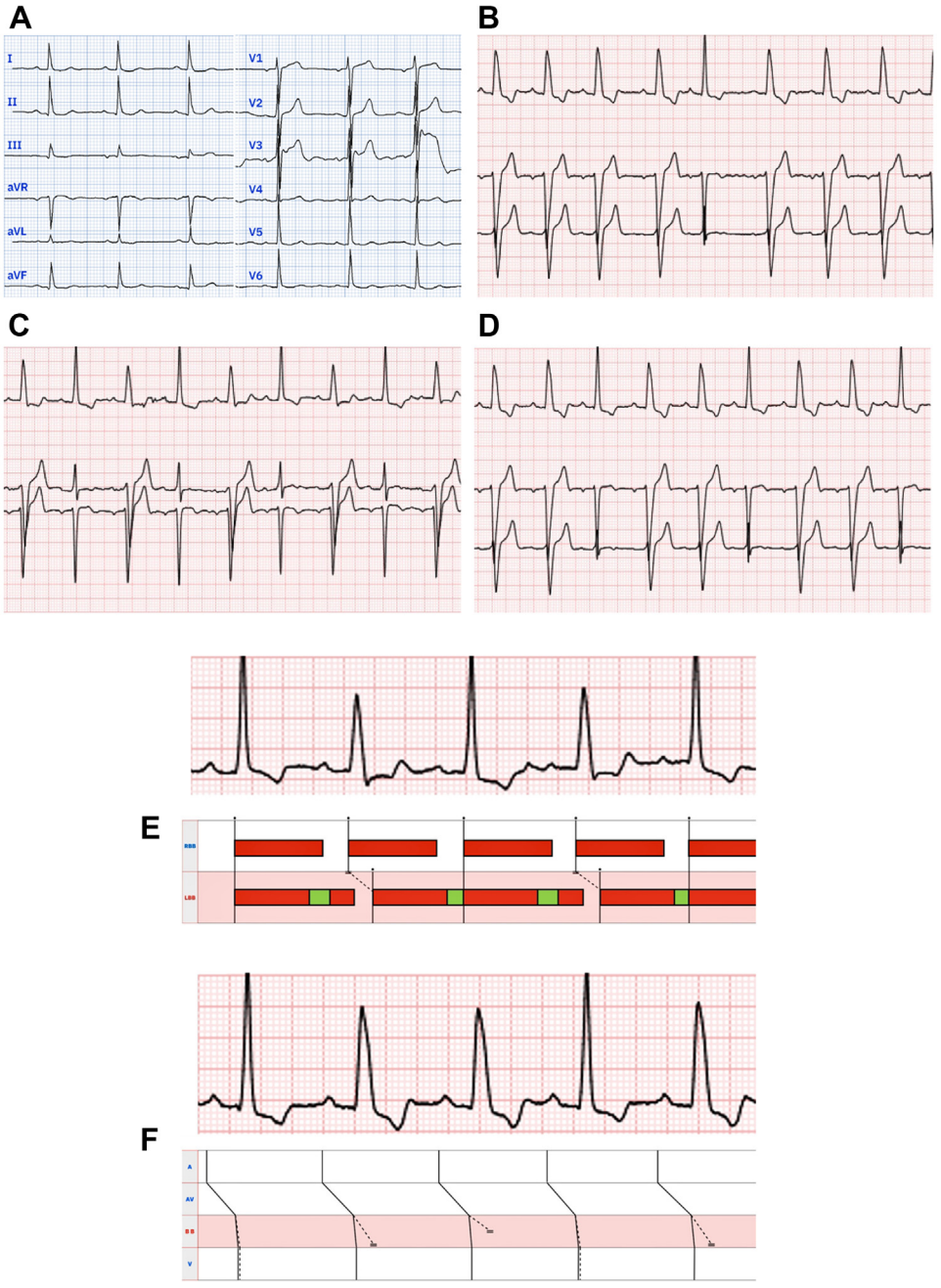
2. Oreto G, *I* Disordini Del Ritmo Cardiaco. *Diagnosi delle aritmie cardiache all'Elettrocardiogramma di superficie*. Centro Scientifico Editore; 1997.

3. Friedberg HD, Schamroth L. Concealed Wenckebach phenomena in the left bundle-branch. *Br Heart J*. 1972;34(4):370–373.

KEY WORDS electrocardiogram, LBBB, linking, supernormal conduction, TAVR, Wenckebach

APPENDIX For supplemental figures, please see the online version of this paper.

FIGURE 1 **Sporadic Narrow QRS Complexes in the Context of an LBBB**



(A) Electrocardiography on admission. Normal sinus rhythm with normal intraventricular conduction. Loose lead artifacts can be seen in lead V_3. **(B)** Premature atrial beats followed by narrower QRS complexes. **(C)** Alternating intermittent left bundle branch block (LBBB). **(D)** Allorhythmic distribution of beats with improved conduction of the impulse. **(E)** Supernormal conduction facilitated by concomitant presence of concealed retrograde activation of the affected bundle branch (linking phenomenon). The refractory period of the left bundle branch (LBB) is prolonged and comprises a small supernormal conduction period. In wide complexes, the impulse is conducted via the right bundle branch, while the LBB is activated late and in a retrograde direction; the LBB depolarization is delayed, and the next impulse occurs during the supernormal phase. **(F)** The concealed Wenckebach phenomenon in the LBB. Progressively slower conduction occurs in the LBB until one sinus impulse is completely blocked, followed by a normally conducted impulse (narrow QRS). In subsequent impulses, the ventricles are depolarized by the right bundle branch and an electrocardiography pattern of complete LBBB appears. See Supplemental Figures 1 to 5 for longer tracings.